a coupler device having first and second RF I/O ports, and in-phase and quadrature ports;

a switch circuit comprising a plurality of single-pole-single-throw (SPST) micro-electro-mechanical ("MEM") switches responsive to control signals, said switch circuit arranged to select one of a plurality of discrete phase shift values introduced by the phase shifter circuit to RF signals passed between the first and second RF ports, said circuits connected to provide a single-pole-multiple-throw (SPMT) or multiple-pole-multiple-throw (MPMT) switch function;

said MEM switch circuit including first and second reactance switch circuits selectively coupling first and second termination reactance circuits respectively to the in-phase and quadrature ports, each said reactance circuit including a plurality of selectable reactance values connected in parallel which are selectable individually or in parallel combinations to select different phase shift values.

REMARKS

The Examiner is thanked for the careful review of the application as set out in the outstanding office action. Reconsideration of the application is respectfully requested.

A marked up version of the changes made to the application showing the changes made is attached hereto.

In the outstanding office action, the drawings have been objected to. Claims 1, 2, 5-9, 13-17 and 21-24 have been rejected under 35 USC § 102 as being anticipated by Honig, Claims 3, 10, 13, 18 and 21 have been rejected under

35 USC § 103 as being unpatentable over Honig, and Claims 4, 11, 12, 19 and 20 have been rejected under 35 USC § 103 as being unpatentable over Honig in view of Nakahara.

The objection to the drawings has been addressed by the foregoing amendments to the specification.

Claims 1-4, 6-8, 10-12, 15-20 and 22-24 have been cancelled without prejudice, Claims 5, 9 and 14 have been amended, and new Claims 25-33 have been added.

Applicants respectfully submit that Claims 25-33 are not anticipated or rendered obvious by the applied art.

Claim 25 is drawn to an array including phase shifters, the phase shifters including switched line phase shifters including a reference signal path and at least one phase shift signal path, and wherein a single MEM switch selects the reference signal path. The invention of Claim 25 is not disclosed or suggested by Honig. The Examiner has asserted at paragraph 9 of the office action that Honig shows that switch 36b selects the reference path. Applicants disagree, and point out that the reference path is not selected by a single MEM switch 36b, but instead is selected by two switches 36b and 36e.

Claim 26 recites that the single MEM switch of Claim 25 provides the reference signal path. This is further distinguished from Honig, wherein the reference path includes a transmission line 34b. The invention of Claim 26 permits the other signal paths to be shorter, and thus result in a phase shifter circuit which can be smaller and lower loss than circuits employing discrete transmission line to provide the reference signal path.

Claim 27 is drawn to an array including an array of reflection phase shifters, including a plurality of micro-electro-mechanical ("MEM") switches responsive to said

control signals to select one of a discrete number of phase shift settings for the respective phase shifter, a coupler device having first and second RF I/O ports, and in-phase and quadrature ports, and first and second reactance circuits respectively coupled to the in-phase and quadrature ports by first and second MEM switch circuits, said first and second reactance circuits each comprising a plurality of susceptances connected in parallel for terminating said in-phase or quadrature port, and wherein first and second MEM switch circuits select at least one of said plurality of susceptances connected in parallel for each of said first and second reactance circuits to select a phase shift setting, and wherein said plurality of susceptances can be selected individually and in parallel combinations. Neither Honig nor Nakahara disclose or suggest a reflection phase shifter having first and second reactance circuits as recited in Claim 27. Selecting individually and in parallel combinations of terminating susceptances is not taught or suggested by the applied art.

New Claims 28-29 depend from Claim 27, and further distinguish from the applied art. For example, Claim 28 recites that the MEM switch circuits comprise first, second and third susceptances each terminated respectively in a first, second or third one of the susceptances. Claim 29 recites that the plurality of susceptances can be switched individually and in parallel combinations to provide at least eight different discrete phase settings.

Claim 30 recites an RF switched line phase shift circuit, and further includes a reference phase signal path and at least one phase shift path, the switch circuit arranged to select one of the reference or the at least one signal paths in response to phase shift control signals,

and wherein a single MEM switch selects the reference signal path. This claim is distinguished from the art of record for reasons analogous to those discussed above regarding Claim 25.

Claim 31 is drawn to an RF reflection phase shifter circuit, wherein the MEM switch circuit includes first and second reactance switch circuits selectively coupling first and second termination reactance circuits respectively to the in-phase and quadrature ports, each said reactance circuit including a plurality of selectable reactance values connected in parallel which are selectable individually or in parallel combinations to select different phase shift values. Neither Honig nor Nakahara alone or in combination teach or suggest such a circuit. Similar considerations apply to the multi-section RF phase shifter circuit of Claim 33.

Claim 32 is drawn to a multi-section RF phase shifter circuit, wherein each phase shift section includes a reference signal path selected by a single MEM switch. This claim is distinguished from the art of record for reasons analogous to those discussed above regarding Claim 25.

Claims 5, 7-9, 13-14 and 21 depend directly or indirectly from allowable independent claims, and are also in condition for allowance.

Conclusion

The outstanding objections and rejections have been addressed, and the application is now in condition for allowance. Such favorable reconsideration is solicited.

Respectfully submitted,

Dated: January 10, 2002

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION

The paragraph bridging pages 8-9 has been amended as follows:

--In accordance with an aspect of the invention, a new class of switched line phase shifter configurations using RF MEM switches is provided. FIG. 4A illustrates a schematic of a 1 bit, hybrid switched line phase shift section 100, or "unit cell." Like conventional PIN diode and FET switched phase shifters, the phase shifter is realized by switching in different lengths of transmission lines (FIG. 4). Unlike PIN diode and FET switches, DC bias used to actuate the metal-metal RF MEMS switches is not coupled to the RF transmission line. This embodiment of the unit cell is fabricated on a low-loss substrate 102, e.g. alumina. A conductor pattern is fabricated on the top surface of the substrate to define the RF ports [102, 104] 104, 106, and the reference transmission line path 108 and phase shift transmission line path 110. The MEM switch 50A is connected by wire bond connections 112, 114 between the port [102] 104 and one end of the reference path 108. Elements of the switch 50A are diagrammatically shown in FIG. 4, including the RF ports indicated as 50A-1 and 50A-2 to which the wire bond connections are made. The cantilever beam is shown as element 50A-3. The DC bias connections are made at 50A-4 and 50A-5. The other end of the reference path 108 is connected though switch 50B to the RF port [104] 106.--

The paragraph bridging pages 10-11 has been amended to the following:

--FIG. 6B shows a "4.5" bit phase shifter 150 using SP3T switch circuits. This circuit has three sections 152, 154, 156, instead of two sections as in the circuit 140. Each section has two SP3T MEM switches to select a reference path, a first phase shift path or a second phase shift path. The sections are connected in series [by paths 155, 157].--

IN THE CLAIMS:

5. (Amended) The array of Claim [1] 25 wherein said MEM switches are single-pole-single-throw (SPST) switches including an armature for opening and closing the RF signal path through the switch, and a control signal path, and wherein the control signals are isolated from the RF signal path.

9. (Amended) The circuit of Claim [8] 30, wherein said single MEM switch provides said reference signal path.

14. (Amended) The circuit of Claim [6] 30, wherein said MEM switches are metal-metal contact RF MEMS series switches.

21. (Amended) The circuit of Claim [20] 27, wherein said first and second MEM switch circuits provide MPMT switching functions.